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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 175.

Home Manufacture and Use of Unfermented Grape Juice.

BY

GEORGE C. HUSMANN,

Expert in Charge of Viticultural Investigations, Bureau of Plant Industry, U. S. Department of Agriculture.

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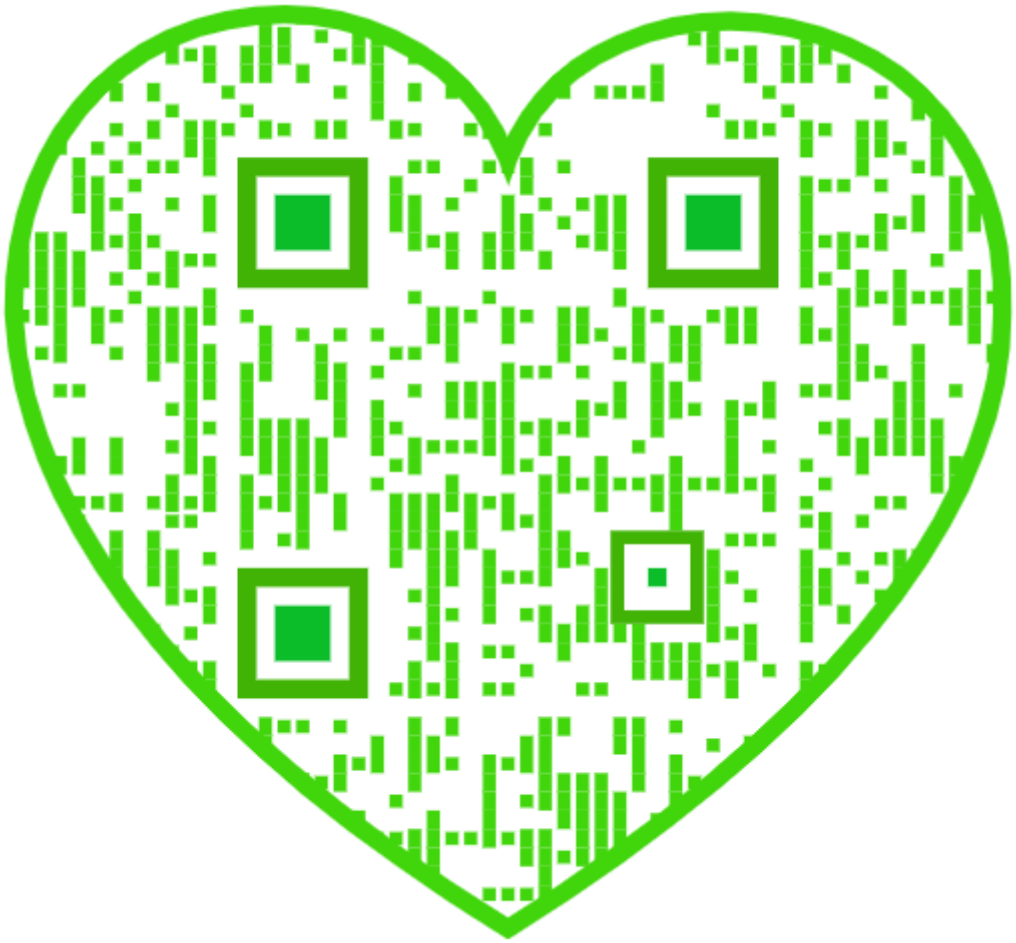

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Washington, D. C., May 28, 1903.

Sir: I have the honor to transmit herewith a paper on Home manufacture and use of unfermented grape juice, by Mr. George C. Husmann, expert in charge of viticultural investigations in this Bureau, and to recommend it for publication as a Farmers' Bulletin.

Part of the matter contained in this paper has already been published in Bulletin No. 24 of this Bureau on the Manufacture and Preservation of Unfermented Grape Must, but the widespread interest in the subject and the demand for information regarding appliances and methods of manufacture adapted to the ordinary farm and kitchen makes desirable its wider circulation through the Farmers' Bulletin series.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson, *Secretary.*

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HOME MANUFACTURE AND USE OF UNFERMENTED GRAPE JUICE.

INTRODUCTION.

Unfermented grape juice has no doubt been used ever since wine has been made from the grape. The following practical suggestions will enable housewives to put up unfermented juice at the time of the fruit harvest, and thus to utilize much fruit that is now annually lost through inability to preserve it in the fresh state. In this form it is a pleasant, wholesome drink and food well adapted to home use. On some farms enough such preventable wastes occur almost every year to largely reduce the possible profits, or even to cause failure to meet the running expenses of the farm. By preventing these wastes an unprofitable farm may often be made profitable.

HISTORICAL NOTES.

Galenius, the Greek physician and writer says (A. D. 131): "A good many Asiatic wines were stored in bottles which were hung in the corner of fireplaces, where, by evaporation, they became dry." This process was called "fumarium."

The Greeks had two kinds of wine, "protoplon," or first juice of the grape before pressing, and "denterion," or pressed juice. The Romans called them "vinum primarium" and "vinum secondarium." Some of them drank the juice before fermentation had started, and called it "mustum." After the must or juice had been through a heating process (called "reduction" nowadays), they called it "frutum," and when, after long heating, it had been reduced to one-half or one-third its original volume, they called it "sapa." This was used by the Romans on their bread and was equivalent to what we now call grape syrup.

In Europe physicians often send their patients to the wine-growing districts during vintage time to take daily rations of the fresh juice as it comes from the crusher. This, however, restricts its use to a brief season of the year and to the immediate vicinity of the vineyards, or to individuals who are yet strong enough to undertake the journey.

Of late years repeated efforts have been made to prevent the juice from fermenting and to preserve it in vessels of such size and shape as can be easily transported, thus rendering its use possible at all times of the year. Until recently its use has been almost exclusively restricted to juice for medicinal or sacramental purposes. Unrestricted and general use has been retarded through lack of knowledge of the principles underlying the process of manufacture. This lack of knowledge and of the necessary skill in applying it has resulted in many failures, thus rendering the production of a good article uncertain and expensive.

COMPOSITION OF THE GRAPE.

The grape contains 12 to 28 per cent of sugar, about 2 to 3 per cent of nitrogenous substances, and some tartaric and malic acids. The skins contain tannin, cream of tartar, and coloring matter. The seeds contain tannin, starchy matters, and fat. The stems contain tannin, diverse acids, and mucilaginous matter. The value of the juice made from any grape is determined by the relative proportion and composition of these various parts.

CAUSES OF FERMENTATION.

It is well known that grapes and other fruits when ripe have the invisible spores of various fungi, yeasts (ferments), and bacteria adhering to their skins and stems. When dry these spores are inert, but after the grapes are crushed and the spores are immersed in the juice they become active and begin to multiply. If the juice is warm, the changes take place rapidly; if, on the other hand, it is cool, the change is slower. But in either case, if left alone, the organisms increase until the juice ferments. The most favorable temperature for fermentation is between 65° F. and 88° F. Cold checks, but does not kill, the ferment. This fermentation, now commonly called the elliptic yeast, changes the sugar in the grape to alcohol and carbonic-acid gas, and is the leading factor in converting must[a] into wine. Hence it will be readily seen that to keep grape juice sweet fermentation must be prevented, and to be salable the product must be clear, bright, and attractive.

METHODS OF PREVENTING FERMENTATION.

Fermentation may be prevented in either of two ways:

(1) By chemical methods, which consist in the addition of germ poisons or antiseptics, which either kill the germs or prevent their growth. Of these the principal ones used are salicylic, sulphurous,

[a] The word "must" as used in wine making invariably refers to the unfermented juice of the grape and is so used in this publication.

boracic, and benzoic acids, formalin, fluorides, and saccharin. As these substances are generally regarded as adulterants and injurious, their use is not recommended.

(2) Mechanical means are sometimes employed. The germs are either removed by some mechanical means, such as filtering or a centrifugal apparatus, or they are destroyed by heat, electricity, etc. Of these, heat has so far been found the most practical.

When a liquid is heated to a sufficiently high temperature all organisms in it are killed. The degree of heat required, however, differs not only with the particular kind of organism, but also with the liquid in which they are held. Time is also a factor. An organism may not be killed if heated to a high temperature and quickly cooled. If, however, the temperature is kept at the same high degree for some time, it will be killed. It must also be borne in mind that fungi, including yeasts, exist in the growing and the resting states, the latter being much more resistant than the former. A characteristic of the fungi and their spores is their great resistance to heat when dry. In this state they can be heated to 212° F. without being killed. The spores of the common mold are even more resistant. This should be well considered in sterilizing bottles and corks, which should be steamed to 240° F. for at least fifteen minutes.

Practical tests so far made indicate that grape juice can be safely sterilized at from 165° F. to 176° F. At this temperature the flavor is hardly changed, while at a temperature much above 200° F. it is. This is an important point, as the flavor and quality of the product depend on it.

This bulletin being intended for the farmer or the housewife only, the writer refers such readers as desire to go into the manufacture of grape juice in a systematic manner for commercial purposes to Bulletin 24, Bureau of Plant Industry, Department of Agriculture, on the same subject, this publication treating only of methods that can be applied in every home.

HOME MANUFACTURE.

Use only clean, sound, well-ripened but not over-ripe grapes. If an ordinary cider mill is at hand, it may be used for crushing and pressing, or the grapes may be crushed and pressed with the hands. If a light-colored juice is desired, put the crushed grapes in a cleanly washed cloth sack and tie up. Then either hang up securely and twist it or let two persons take hold, one on each end of the sack (fig. 1, p. 8), and twist until the greater part of the juice is expressed. Then gradually heat the juice in a double boiler or a large stone jar in a pan of hot water, so that the juice does not come in direct contact with the fire, at a temperature of 180° F. to 200° F.; never above 200° F. It

is best to use a thermometer, but if there be none at hand heat the juice until it steams, but do not allow it to boil. Put it in a glass or enameled vessel to settle for twenty-four hours; carefully drain the juice from the sediment, and run it through several thicknesses of clean flannel, or a conic filter made from woolen cloth or felt may be used. This filter is fixed to a hoop of iron, which can be suspended wherever necessary (fig. 2). After this fill into clean bottles. Do not fill entirely, but leave room for the liquid to expand when again heated. Fit a thin board over the bottom of an ordinary wash boiler (fig. 3), set the filled bottles (ordinary glass fruit jars are just as good) in it, fill in with water around the bottles to within about an inch of the tops, and gradually heat until it is about to simmer. Then take the bottles out and cork or seal immediately. It is a good idea to take the further precaution of sealing the corks over with sealing wax or paraffin to prevent mold germs from entering through the corks. Should it be desired to make a red juice, heat the crushed grapes to not above 200° F., strain through a clean cloth or drip bag, as shown in fig. 4 (no pressure should be used), set away to cool and settle, and proceed the same as with light-colored juice. Many people do not even go to the trouble of letting the juice settle after straining it, but reheat and seal it up immediately, simply setting the vessels away in

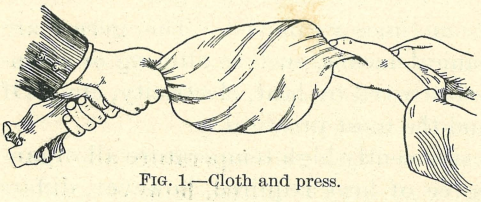

FIG. 1.—Cloth and press.

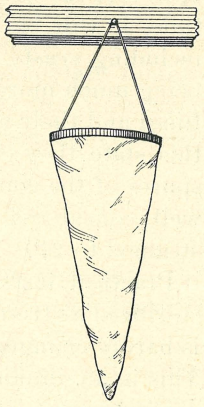

FIG. 2.—Cloth or felt filter.

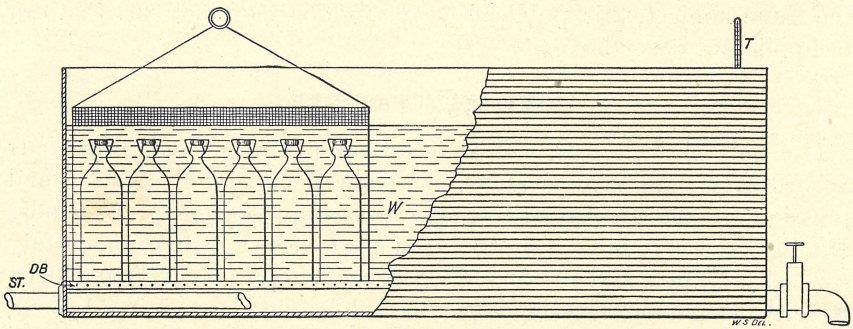

FIG. 3.—Pasteurizer fo juice in bottles: *DB*, Double bottom. *ST*, Steam pipe. *W*, Water bath. *T*, Thermometer. (Bottle shows method of adjusting a cork holder of sheet metal.)

a cool place in an upright position where they will be undisturbed. The juice is thus allowed to settle, and when wanted for use the clear

juice is simply taken off the sediment. Any person familiar with the process of canning fruit can also preserve grape juice, for the principles involved are identical.

One of the leading defects so far found in unfermented juice is that much of it is not clear, a condition which very much detracts from its otherwise attractive appearance and due to two causes already alluded to. Either the final sterilization in bottles has been at a higher temperature than the preceding one, or the juice has not been properly filtered or has not been filtered at all. In other cases the juice has been sterilized at such a high temperature that it has a disagreeable scorched taste. It should be remembered that attempts to sterilize at a temperature above 195° F. are dangerous, so far as the flavor of the finished product is concerned.

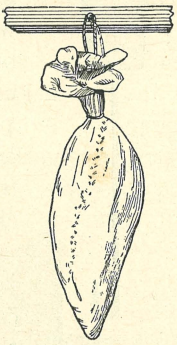

FIG. 4.—Drip bag.

Another serious mistake is sometimes made by putting the juice into bottles so large that much of it becomes spoiled before it is used after the bottles are opened. Unfermented grape juice properly made and bottled will keep indefinitely, if it is not exposed to the atmosphere or mold germs; but when a bottle is once opened it should, like canned goods, be used as soon as possible, to keep it from spoiling.

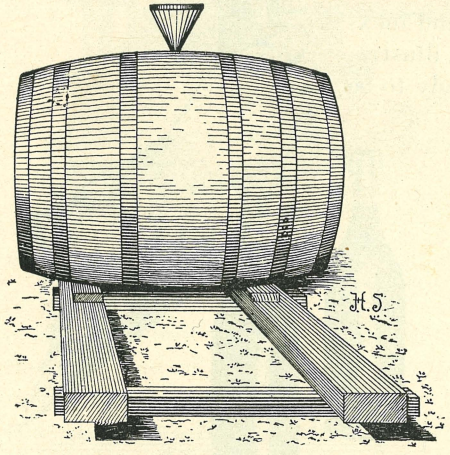

FIG. 5.—Barrel and skid.

MANUFACTURE OF LARGER QUANTITIES.

Another method of making unfermented grape juice, which is often resorted to where a sufficiently large quantity is made at one time, consists in this:

Take a clean keg or barrel (one that has previously been made sweet). Lay this upon a skid consisting of two scantlings or pieces of timber of perhaps 20 feet long, in such a manner as to make a runway (fig. 5). Then take a sulphur match, made by dipping strips of clean muslin about 1 inch wide and 10 inches long into melted brimstone, cool it and attach it to a piece of wire fastened in the lower end of a bung and bent over at the end, so as to form a hook (fig. 6). Light the match and by means of the wire suspend it in the barrel, bung the barrel up tight, and allow it to burn as long as it will. Repeat this until fresh sulphur matches will no longer burn in the barrel.

Then take enough fresh grape juice to fill the barrel one-third full, bung up tight, and roll and agitate violently on the skid for a few minutes. Then burn more sulphur matches in it until no more will burn, fill in more juice until the barrel is about two-thirds full; agitate and roll again. Repeat the burning process as before, after which fill the barrel completely with grape juice and roll. The barrel should then be bunged tightly and stored in a cool place with the bung up, and so secured that the package can not be shaken. In the course of a few weeks the juice will have become clear and can then be racked off and filled into bottles or jars direct, sterilized, and corked or sealed up ready for use. By this method, however, unless skillfully handled, the juice is apt to have a slight taste of the sulphur.

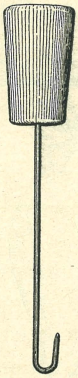

FIG. 6.—Sulphur hook.

A FEW USEFUL APPLIANCES.

Fig. 7 shows a very practical and inexpensive corking machine. The illustration shows the cork in place, ready to be driven through the tapering hole in the machine into the neck of the bottle underneath. The corks should be put in hot water and allowed to stand for a few minutes before using in order to soften and make them pliable. This enables one to use a cork large enough to seal securely.

Care should be taken to set the bottles on a flat piece of rubber or on a piece of cloth folded several times, as shown in the figure, so as to take the jar of the blow when the cork is driven. It is even a wise precaution to have a pan underneath, as it frequently occurs that bottles thought to be entirely good have blemishes and break.

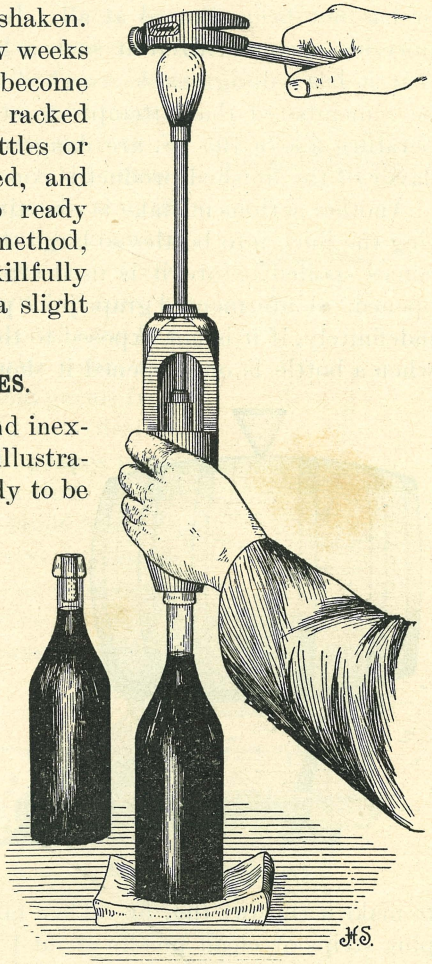

FIG. 7.—Corking machine.

An ordinary cider press is not expensive; nevertheless the majority of farms do not have one, and it frequently occurs that a farm is located

so far away from any establishment dealing in such implements that the fruit might spoil or not be sufficiently valuable to justify the purchase price and time lost and expense incurred in getting it. Fig. 8 gives an illustration of a lever press, very efficient for this and similar uses, which any farmer handy with tools can make, the material for which can be found on almost any farm at any time. The press consists of the following parts:

Two upright posts (F) set deep and firmly in the ground side by side and about 12 inches apart. (It is a good idea to attach some deadmen to them in the ground to prevent them pulling out too easily.) Between these posts the lever (E) is hung by means of a bolt (T), or the lever may be hung to the side of a building, or a hole notched into a tree large

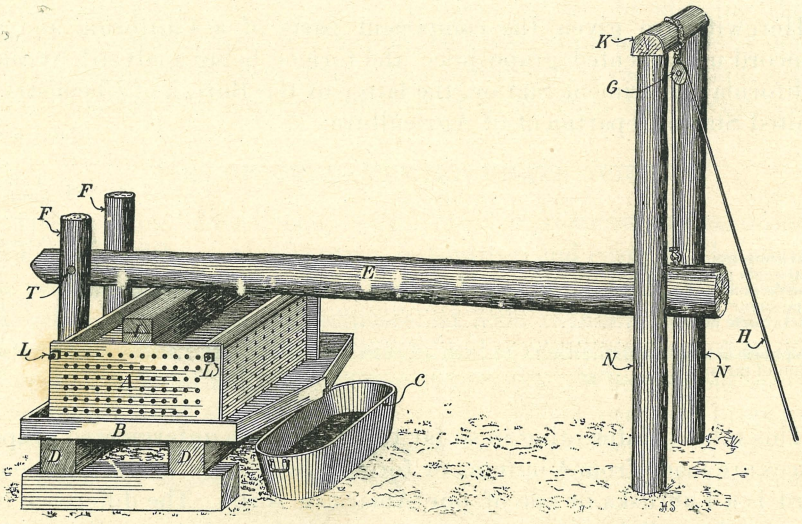

FIG. 8.—Home-made lever press. A, Press basket. B, Press bottom. C, Tub. D, Skids. E, Lever. F, Upright posts. G, Block and tackle. T, Lever bolt. I, Press block.

enough to admit the end of the lever and a bolt run through that. At the other end of the lever are two posts, so set that the lever can be raised up between them by means of block and tackle. The press itself consists of two timbers (D), on which the press bottom (B) rests, and on this bottom is the press basket, consisting of the two sides and two ends, and so constructed that it can be easily taken apart and set up again, being held together at the ends by means of rods (L). The sides and ends should be bored full of small holes from three-eighths to one-half inch in diameter to allow exit for the juice.

After the press is filled, the top (which is made to fit in the inside of the basket) and cross blocks (I) are put on and the lever is then allowed to press down on it. A press like this has the advantage that it can be filled in the evening and left to press until morning while the farmer

sleeps. The precaution, of course, must be taken to set a tub (C) large enough to hold the juice under the press.

It is perhaps well to state that the longer and heavier the lever the greater the pressure it exerts. Where it is not convenient to make the lever very long, weights are placed or hung on the outer extremity of the lever to increase the pressure. It will thus be seen that with a little ingenuity a person can adapt the press to suit his individual requirements.

For ordinary purposes a press basket 3 feet square and 2 feet high will be found a very convenient size. This will accommodate a ton of crushed grapes.

COMPOSITION OF UNFERMENTED GRAPE JUICE.

Herewith are given the component parts of a California and a Concord unfermented grape juice, the former being analyzed by the California Experiment Station, the latter by the Bureau of Chemistry, United States Department of Agriculture:

	Concord.	California.
	Per cent.	*Per cent.*
Solid contents	20.37	20.60
Total acids (as tartaric)	.663	.53
Volatile acids	.023	.03
Grape sugar	18.54	19.15
Free tartaric acids	.025	.07
Ash	.255	.19
Phosphoric acids	.027	.04
Cream of tartar	.55	.59

This table is interesting in so far that California unfermented grape juices are made from Viniferas or foreign varieties, whereas the Concord is a Labruska or one of our American sorts. The difference in taste and smell is even more pronounced than the analysis would indicate.

FLAVOR AND QUALITY IN GRAPE JUICE.

In the making of unfermented grape juice a great deal of judgment can be displayed and many variations produced so as to suit almost any taste by the careful selection of the varieties of grapes from which it is made. From the Mission grape, for instance, when fully ripe, a juice would be obtained that would be delicate and simply sweet, without any other taste; from the Muscat we would get that rich musky flavor found in our leading raisins; in the Concord that sprightly foxy taste so well known; in the Catawba or Isabella that fragrance so peculiarly their own, and in the Iona a pleasing, mild, yet just pronounced enough aroma and taste to strike the right spot. Thus we might continue along the list.

Equally as pronounced variations in color can be had, as, for instance, almost colorless, yellow, orange, light red, red, and a deep purple.

The writer has often been asked what kind of grapes should be used in making unfermented grape juice, when, as a matter of fact, it can be made from any grape; not only this, but unfermented juice is made from other fruits as well, for instance, apples, pears, cherries—and berries of different kinds yield excellent juices. It is really good judgment in selecting the right varieties when planting for fruit production. That also determines the quality of our unfermented juice. For instance, the richer, sweeter, and better in quality the fruit we use, the richer, sweeter, and better will be our unfermented juice. If, on the other hand, the fruit is sour, green, and insipid, the juice will be likewise. As stated before, the intention of this bulletion is to show how to avoid some wastes, and to increase income by utilizing those products of which there is a surplus, and instead of, as is usually done, letting them rot, convert them into something that can be kept, used, and disposed of at any time when desired, or when fresh fruit is not available.

USES OF UNFERMENTED GRAPE JUICE.

The uses are indeed many. It is used in sickness, convalescence, and good health; as a preventive, restorative, and cure; by the young, by persons in the prime of life, and by those in old age. It is used in churches for sacramental purposes; at soda fountains as a cool and refreshing drink; in homes, at hotels, and at restaurants as a food, as a beverage, as a dessert, and in many other ways. When people become accustomed to it they rarely give it up. When properly prepared, unfermented grape juice can be made to please the eye by its color and attractive appearance, the sense of smell by its aroma or fragrance, the palate by its pleasant flavor.

It is food and drink, refreshment and nourishment, all in one. Not a by product, but made from fruit going to waste—one of the blessings given us, that some are too careless, others too ignorant, to make use of.

FOOD VALUE OF UNFERMENTED GRAPE JUICE.

The effects of unfermented grape juice on the human system have been studied for a number of years, especially at the so-called grape cures so long in vogue in Europe. A smaller number of investigations have been made in laboratories.

It is quite generally claimed that using a reasonably large amount of unfermented grape juice with an otherwise suitable mixed diet is beneficial and that digestion is improved, intestinal fermentation diminished, and that gains in body weight result. It should not be forgotten that the abundant diet and hygienic methods of living practiced at the

grape cures play an important part, but even taking all this into account it seems fair to conclude that some of the good results can be directly attributed to the unfermented grape juice.

Grape juice contains the same kinds of nutrients as other foods. The percentage of water is high, and thus it resembles liquid foods more closely than solid foods. It is sometimes compared with milk, the most common liquid food. It contains less water than milk, more carbohydrates, and less protein, fat, and ash. Carbohydrates, largely present in the form of sugar, are the principal nutritive ingredients. It is evident, therefore, that grape juice is essentially an energy yielding food, and may help the body to become fatter, though it can not materially assist in building nitrogenous tissue. Sugars in moderate amounts are wholesome foods, and grape juice offers such material in a reasonably dilute as well as palatable form. Undoubtedly the agreeable flavor increases the appetite, a by no means unimportant consideration.

A FEW GOOD RECIPES.

GRAPE NECTAR.

Take the juice of 2 lemons and 1 orange, 1 pint of grape juice, 1 small cup of sugar, and a pint of water. Serve ice cold. If served from punch bowl, sliced lemon and orange add to the appearance.

AN INVALID DRINK.

Put in the bottom of a wineglass 2 tablespoonfuls of grape juice; add to this the beaten white of 1 egg and a little chopped ice; sprinkle sugar over the top and serve. This is often served in sanitariums.

GRAPE PUNCH.

Boil together 1 pound of sugar and half a pint of water until it spins a thread; take from the fire and when cool add the juice of 6 lemons and a quart of grape juice. Stand aside overnight. Serve with plain water, apollinaris, or soda water.

GRAPE SHERBET.

For 8 persons mix 1 pint of grape juice (unfermented), juice of lemon and 1 heaping tablespoonful of gelatine, dissolved in boiling water; freeze quickly; add beaten white of 1 egg just before finish.

GRAPE ICE CREAM.

One quart of unfermented grape juice, 1 quart of cream, 1 pound of sugar, and the juice of 1 lemon.

SYLLABUB.

One quart of fresh cream, whites of 4 eggs, 1 glass of grape juice, 2 small cups of powdered sugar; whip half the sugar with the cream, the balance with the eggs; mix well; add grape juice and pour over sweetened strawberries and pineapples, or oranges and bananas. Serve cold.

BOHEMIAN CREAM.

One pint thick cream, 1 pint grape-juice jelly; stir together; put in cups and set on ice. Serve with lady fingers.

Besides the recipes just given many more are enumerated, such as grape ice, grape lemonade, grape water ice, grape juice and egg, baked bananas, snow pudding, grape gelatine, junket and grape jelly, tutti-frutti jelly, grape float, grape jelly, grape juice plain, grape soda water, and scores of others.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C. The missing numbers have been discontinued, being superseded by later bulletins.

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